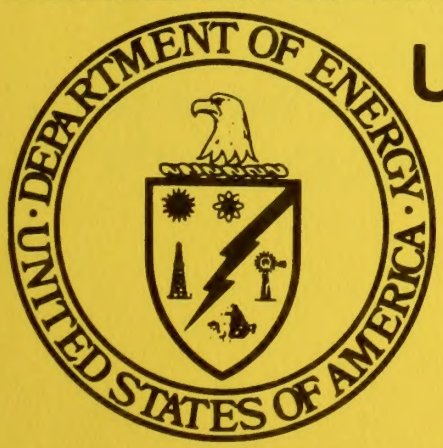
SOLAR/1040-79/05

Monthly Performance Report

SADDLE HILL TRUST

LOT 77

MAY 1979



U.S. Department of Energy

National Solar Heating and Cooling Demonstration Program

National Solar Data Program

MONTHLY PERFORMANCE REPORT

SADDLE HILL TRUST
LOT 77

MAY 1979

I. SYSTEM DESCRIPTION

Saddle Hill Trust Lot 77 is a single-family residence in Medway, Massachusetts. Solar energy is used for preheating incoming city water. The solar energy system has an array of flat-plate collectors with a gross area of 78 square feet. The array faces south at an angle of 38 degrees to the horizontal. Air is used as the medium for delivering solar energy from the collector array to an air-to-liquid heat exchanger located in the collector air duct. Water is the medium used to transport solar energy from the heat exchanger to storage. Solar energy is stored in the basement in a 120-gallon preheat storage tank. This preheated city water is supplied, on demand, to a conventional 40-gallon domestic-hot-water (DHW) tank. When solar energy is insufficient to satisfy the hot water requirements, the gas-driven DHW heater provides auxiliary energy for water heating. The system, shown schematically in Figure 1, has two modes of solar operation.

Mode 1 - Collector-to-Storage: This mode activates when the difference between the temperature of the collector air and the temperature of the water in the preheat tank exceeds 40°F and the temperature of the water in the tank is below 140°F. Both the fan and pump go on. This mode continues until the temperature difference drops to 20°F.

Mode 2 - Storage-to-Space Heating: This mode activates when there is a demand for hot water. Hot water from the top of the preheat tank is transferred to the DHW tank to replace water removed. Simultaneously, city water is automatically supplied to the preheat tank.

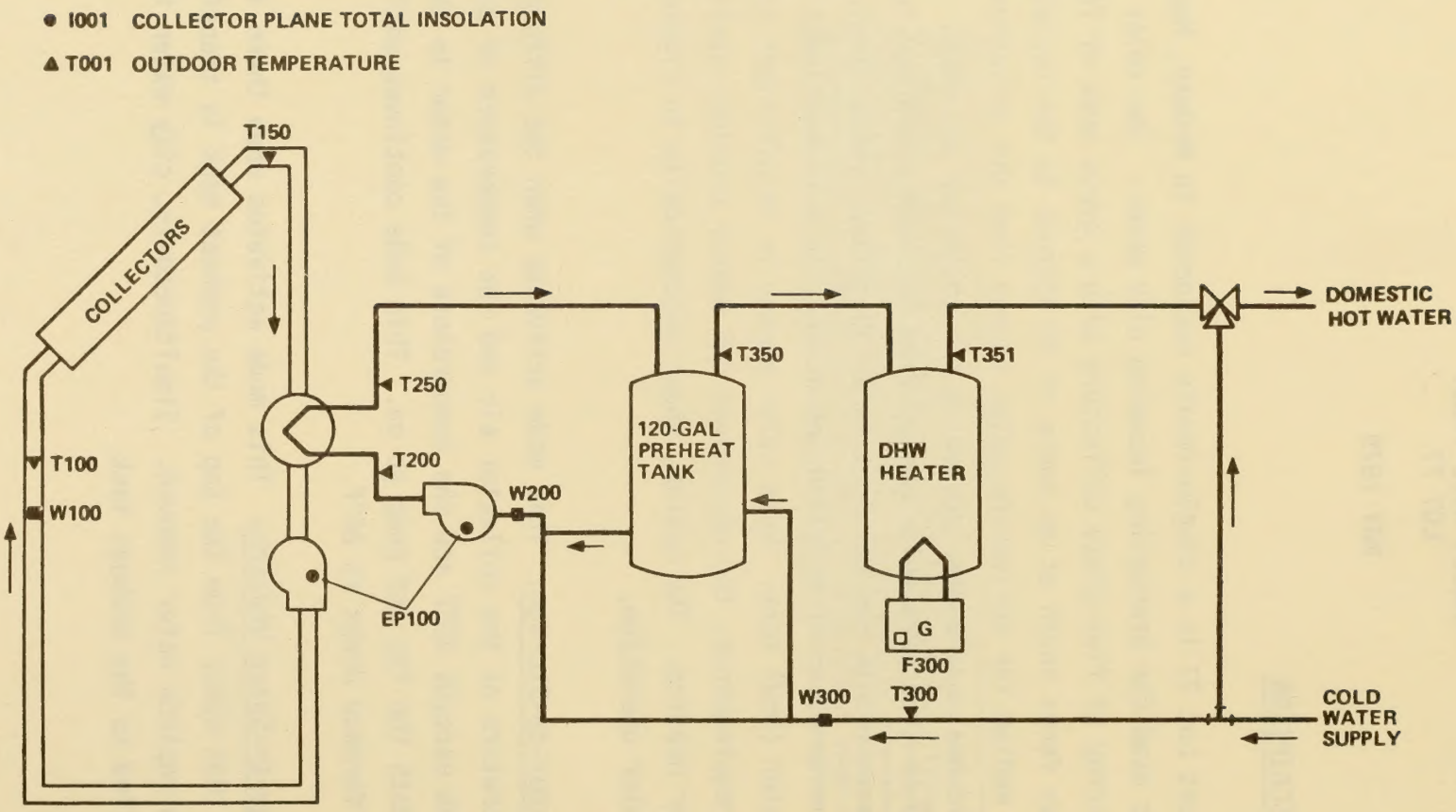


Figure 1. SADDLE HILL TRUST, LOT NO. 77, SOLAR ENERGY SYSTEM SCHEMATIC

II. PERFORMANCE EVALUATION

INTRODUCTION

The site was occupied in May and the solar energy system operated continuously during the month. Total solar energy collected was 1.0 million Btu and the total solar energy used was 0.72 million Btu or 72 percent of the collected energy. Solar energy satisfied 35 percent of the DHW requirements. The solar energy system provided a fossil fuel energy savings of 1.1 million Btu and incurred an electrical energy expense of 0.14 million Btu.

WEATHER CONDITIONS

During the month, total incident solar energy on the collector array was 3.2 million Btu for a daily average of 1315 Btu per square foot. This was below the estimated average daily solar radiation for this geographical area during May of 1502 Btu per square foot for a south-facing plane with a tilt of 38 degrees to the horizontal. The average ambient temperature during May was 61°F as compared with the long-term average for May of 59°F.

THERMAL PERFORMANCE

System - During May the solar energy system performed approximately the same as expected. The expected performance was determined from a modified f-chart analysis using measured weather and subsystem loads as input. Solar energy used by the system was estimated by assuming that all energy collected would be applied to the load. Actual solar energy used was 0.72 million Btu versus an estimated 0.77 million Btu. System total solar fraction was 35 percent versus an estimated 38 percent.

Collector - The total incident solar radiation on the collector array for the month of May was 3.2 million Btu. During the period the collector loop was operating, the total insolation amounted to 2.8 million Btu. The total collected solar energy for the month of May was 1.0 million Btu, resulting in a collector array efficiency of 32 percent, based on total incident insolation. Operating energy required by the collector loop was 0.14 million Btu.

DHW Load - The DHW subsystem consumed 0.72 million Btu of solar energy and 2.2 million Btu of auxiliary fossil fuel energy to satisfy a hot water load of 1.7 million Btu. The solar fraction of this load was 35 percent. Losses from the DHW subsystem were 0.34 million Btu. A daily average of 75 gallons of DHW was consumed at an average temperature of 139°F delivered from the tank.

OBSERVATIONS

No significant observations to report.

ENERGY SAVINGS

The solar energy system provided fossil fuel energy savings of 1.1 million Btu, while incurring an electrical energy expense of 0.14 million Btu.

III. ACTION STATUS

No significant items pending.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SITE SUMMARY

SITE: SADDLE HILLS TRUST LOT #77, MEDWAY,MA 02053 SOLAR/1039-79/05
REPORT PERIOD: MAY,1979

SITE/SYSTEM DESCRIPTION:
THE SADDLE HILL TRUST, LOT 77, SOLAR SYSTEM PROVIDES YEAR ROUND HOT WATER TO A SINGLE FAMILY DETACHED HOUSE. THE COLLECTOR IS A FOUR-PANEL AIR COLLECTOR. STORAGE IS A 120 GALLON WATER TANK. AUXILIARY HOT WATER IS PROVIDED BY A GAS DOMESTIC HOT WATER HEATER.

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY	3.180 MILLION BTU
	40769 BTU/SQ.FT.
COLLECTED SOLAR ENERGY	1.018 MILLION BTU
	13055 BTU/SQ.FT.
AVERAGE AMBIENT TEMPERATURE	61 DEGREES F
AVERAGE BUILDING TEMPERATURE	N.A. DEGREES F
ECSS SOLAR CONVERSION EFFICIENCY	0.23
ECSS OPERATING ENERGY	0.142 MILLION BTU
TOTAL SYSTEM OPERATING ENERGY	0.142 MILLION BTU
TOTAL ENERGY CONSUMED	3.349 MILLION BTU

SUBSYSTEM SUMMARY:

	HOT WATER	HEATING	COOLING	SYSTEM TOTAL
LOAD	1.700	N.A.	N.A.	1.701 MILLION BTU
SOLAR FRACTION	35	N.A.	N.A.	35 PERCENT
SOLAR ENERGY USED	0.721	N.A.	N.A.	0.721 MILLION BTU
OPERATING ENERGY	N.A.	N.A.	N.A.	0.142 MILLION BTU
AUX. THERMAL ENERGY	1.313	N.A.	N.A.	1.313 MILLION BTU
AUX. ELECTRIC FUEL	N.A.	N.A.	N.A.	N.A. MILLION BTU
AUX. FOSSIL FUEL	2.189	N.A.	N.A.	2.189 MILLION BTU
ELECTRICAL SAVINGS	-0.142	N.A.	N.A.	-0.142 MILLION BTU
FOSSIL SAVINGS	1.092	N.A.	N.A.	1.092 MILLION BTU

SYSTEM PERFORMANCE FACTOR: 0.639

* DENOTES UNAVAILABLE DATA
@ DENOTES NULL DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT OF THE NATIONAL SOLAR DATA PROGRAM, FEBRUARY 28,1978, SOLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SITE SUMMARY

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GENERAL SITE DATA:

INCIDENT SOLAR ENERGY	3.355 GIGA JOULES
	462973 KJ/SQ.M.
COLLECTED SOLAR ENERGY	1.074 GIGA JOULES
	148256 KJ/SQ.M.
AVERAGE AMBIENT TEMPERATURE	16 DEGREES C
AVERAGE BUILDING TEMPERATURE	N.A. DEGREES C
ECSS SOLAR CONVERSION EFFICIENCY	0.23
ECSS OPERATING ENERGY	0.150 GIGA JOULES
TOTAL SYSTEM OPERATING ENERGY	0.150 GIGA JOULES
TOTAL ENERGY CONSUMED	3.533 GIGA JOULES

SUBSYSTEM SUMMARY:

	HOT WATER	HEATING	COOLING	SYSTEM TOTAL
LOAD	1.794	N.A.	N.A.	1.794 GIGA JOULES
SOLAR FRACTION	35	N.A.	N.A.	35 PERCENT
SOLAR ENERGY USED	0.761	N.A.	N.A.	0.761 GIGA JOULES
OPERATING ENERGY	N.A.	N.A.	N.A.	0.150 GIGA JOULES
AUX. THERMAL ENG	1.385	N.A.	N.A.	1.385 GIGA JOULES
AUX. ELECTRIC FUEL	N.A.	N.A.	N.A.	N.A. GIGA JOULES
AUX. FOSSIL FUEL	2.309	N.A.	N.A.	2.309 GIGA JOULES
ELECTRICAL SAVINGS	-0.150	N.A.	N.A.	-0.150 GIGA JOULES
FOSSIL SAVINGS	1.152	N.A.	N.A.	1.152 GIGA JOULES

SYSTEM PERFORMANCE FACTOR: 0.639

* DENOTES UNAVAILABLE DATA
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REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT OF THE NATIONAL SOLAR DATA PROGRAM,FEBRUARY 28,1978, SOLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
ENERGY COLLECTION AND STORAGE SUBSYSTEM (ECSS)

SITE: SADDLE HILLS TRUST LOT #77, MEDWAY,MA 02053 SOLAR/1039-79/05
REPORT PERIOD: MAY,1979

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	AMBIENT TEMP DEG-F	ENERGY TO LOADS MILLION BTU	AUX THERMAL TO ECSS MILLION BTU	ECSS OPERATING ENERGY MILLION BTU	ECSS ENERGY REJECTED MILLION BTU	ECSS SOLAR CONVERSION EFFICIENCY
1	0.152	57	0.037	N	0.007	N	0.247
2	0.185	52	0.014	O	0.007	O	0.075
3	0.134	54	0.021	T	0.006	T	0.153
4	0.131	63	0.044		0.007		0.333
5	0.189	55	0.036	A	0.007	A	0.192
6	0.147	54	0.001	P	0.005	P	0.006
7	0.176	62	0.011	P	0.007	P	0.064
8	0.170	67	0.051	L	0.007	L	0.302
9	0.160	79	0.053	I	0.009	I	0.329
10	0.155	82	0.050	C	0.007	C	0.325
11	0.169	69	0.045	A	0.007	A	0.268
12	0.062	60	0.012	B	0.005	B	0.191
13	0.033	64	0.006	L	0.002	L	0.196
14	0.021	62	0.002	E	0.000	E	0.109
15	0.021	62	0.002		0.000		0.091
16	0.113	65	0.042		0.007		0.371
17	0.133	61	0.030		0.006		0.224
18	0.057	59	0.014		0.003		0.239
19	0.030	54	0.003		0.001		0.095
20	0.030	56	0.002		0.000		0.053
21	0.073	64	0.030		0.006		0.408
22	0.176	65	0.052		0.007		0.294
23	0.032	56	0.002		0.002		0.070
24	0.010	54	0.000		0.000		0.000
25	0.027	58	0.005		0.001		0.194
26	0.064	58	0.005		0.003		0.079
27	0.151	60	0.041		0.007		0.273
28	0.025	60	0.002		0.001		0.097
29	0.148	65	0.048		0.007		0.327
30	0.026	59	0.003		0.002		0.119
31	0.180	66	0.057		0.007		0.314
SUM	3.180	-	0.721	N.A.	0.142	N.A.	-
AVG	0.103	61	0.023	N.A.	0.005	N.A.	0.227
NBS ID	Q001	N113			Q102		N111

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
COLLECTOR ARRAY PERFORMANCE

SITE: SADDLE HILLS TRUST LOT #77, MEDWAY, MA 02053SOLAR/1039-79/05
REPORT PERIOD: MAY,1979

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	OPERATIONAL INCIDENT ENERGY MILLION BTU	COLLECTED SOLAR ENERGY MILLION BTU	DAYTIME AMBIENT TEMP DEG F	COLLECTOR ARRAY EFFICIENCY
1	0.152	0.141	0.051	68	0.334
2	0.185	0.175	0.056	62	0.300
3	0.134	0.120	0.040	69	0.296
4	0.131	0.126	0.051	71	0.394
5	0.189	0.180	0.052	59	0.277
6	0.147	0.138	0.039	61	0.267
7	0.176	0.169	0.058	71	0.329
8	0.170	0.160	0.059	83	0.347
9	0.160	0.152	0.061	89	0.382
10	0.155	0.146	0.056	91	0.364
11	0.169	0.159	0.050	81	0.298
12	0.062	0.045	0.016	*	0.262
13	0.033	0.016	0.008	67	0.238
14	0.021	0.004	0.002	64	0.117
15	0.021	0.003	0.002	64	0.104
16	0.113	0.106	0.048	72	0.426
17	0.133	0.118	0.037	72	0.280
18	0.057	0.042	0.017	63	0.296
19	0.030	0.005	0.004	59	0.117
20	0.030	0.002	0.002	60	0.063
21	0.073	0.062	0.034	69	0.469
22	0.176	0.166	0.061	74	0.343
23	0.032	0.014	0.004	66	0.121
24	0.010	0.000	0.000	55	0.000
25	0.027	0.010	0.006	61	0.230
26	0.064	0.049	0.024	61	0.382
27	0.151	0.140	0.050	68	0.334
28	0.025	0.006	0.003	61	0.125
29	0.148	0.137	0.056	76	0.378
30	0.026	0.012	0.004	63	0.162
31	0.180	0.171	0.065	76	0.363
SUM	3.180	2.775	1.018	-	-
AVG	0.103	0.090	0.033	69	0.320
NBSID	Q001		Q100		N100

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
HOT WATER SUBSYSTEM

SITE: SADDLE HILLS TRUST LOT #77, MEDWAY, MA 02053 SOLAR/1039-79/05
REPORT PERIOD: MAY, 1979

DAY OF MON.	HOT WATER LOAD MILLION BTU	SOLAR FR.OF LOAD PER CENT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FOSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FOSSIL ENERGY SAVINGS MILLION BTU	SUP. WAT. TEMP DEG F	HOT WAT. TEMP DEG F	HOT WATER USED GAL
1	0.063	47	0.037	N	0.042	N	0.071	-0.007	0.050	53	140	86
2	0.043	43	0.014	O	0.031	O	0.051	-0.007	0.038	53	138	58
3	0.094	50	0.021	T	0.052	T	0.086	-0.006	0.089	53	142	119
4	0.036	39	0.044		0.030		0.050	-0.007	0.026	56	138	53
5	0.037	50	0.036	A	0.028	A	0.046	-0.007	0.029	56	136	41
6	0.076	49	0.001	P	0.044	P	0.073	-0.005	0.078	54	140	95
7	*	*	0.011	P	0.053	P	0.088	-0.007	*	*	*	106
8	0.065	54	0.051	L	0.029	L	0.048	-0.007	0.072	54	139	74
9	0.080	65	0.053	I	0.036	I	0.059	-0.008	0.088	56	138	110
10	0.047	54	0.050	C	0.025	C	0.041	-0.007	0.049	61	135	61
11	*	*	0.045	A	0.025	A	0.041	-0.007	*	*	*	64
12	0.039	54	0.012	B	0.021	B	0.035	-0.005	0.042	56	137	58
13	0.084	32	0.006	L	0.068	L	0.114	-0.002	0.042	58	144	112
14	0.039	18	0.002	E	0.039	E	0.064	-0.000	0.011	57	144	53
15	0.038	9	0.002		0.040		0.067	-0.000	0.006	60	137	54
16	0.036	12	0.042		0.039		0.066	-0.007	0.012	59	137	56
17	0.042	35	0.030		0.030		0.049	-0.006	0.035	58	140	57
18	0.074	37	0.014		0.053		0.088	-0.003	0.050	57	144	104
19	0.044	19	0.003		0.045		0.075	-0.001	0.015	58	143	66
20	0.046	11	0.002		0.052		0.087	-0.000	0.008	58	139	62
21	0.036	7	0.030		0.043		0.072	-0.006	0.005	58	139	55
22	0.042	30	0.052		0.032		0.053	-0.007	0.026	61	131	52
23	0.090	45	0.002		0.059		0.099	-0.002	0.067	58	139	132
24	0.040	17	0.000		0.043		0.072	0.000	0.010	59	141	59
25	0.036	6	0.005		0.045		0.076	-0.001	0.004	58	143	53
26	0.067	10	0.005		0.069		0.116	-0.003	0.014	59	142	94
27	0.074	36	0.041		0.054		0.090	-0.007	0.047	58	145	105
28	0.045	27	0.002		0.041		0.068	-0.001	0.019	60	141	62
29	0.043	14	0.048		0.039		0.064	-0.007	0.012	60	129	56
30	0.088	32	0.003		0.066		0.110	-0.002	0.052	59	139	121
31	0.048	24	0.057		0.040		0.067	-0.007	0.025	59	144	59
SUM	1.700	-	0.721	N.A.	1.313	N.A.	2.189	-0.142	1.092	-	-	2340
AVG	0.055	35	0.023	N.A.	0.042	N.A.	0.071	-0.005	0.035	57	139	75
NBS	Q302	N300	Q300	Q303	Q301	Q305	Q306	Q311	Q313	N305	N307	N308

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
ENVIRONMENTAL SUMMARY

SITE: SADDLE HILLS TRUST LOT #77, MEDWAY, MA 02053 SOLAR/1039-79/05
REPORT PERIOD: MAY, 1979

DAY OF MONTH	TOTAL INSOLATION BTU/SQ.FT	DIFFUSE INSOLATION BTU/SQ.FT	AMBIENT TEMPERATURE DEG F	DAYTIME AMBIENT TEMP DEG F	RELATIVE HUMIDITY PERCENT	WIND DIRECTION DEGREES	WIND SPEED M.P.H.
1	1943	N	57	68	N	N	N
2	2372	O	52	62	O	O	O
3	1721	T	54	69	T	T	T
4	1677		63	71			
5	2427	A	55	59	A	A	A
6	1891	P	54	61	P	P	P
7	2251	P	62	71	P	P	P
8	2177	L	67	83	L	L	L
9	2056	I	79	89	I	I	I
10	1988	C	82	91	C	C	C
11	2166	A	69	81	A	A	A
12	791	B	60	*	B	B	B
13	422	L	64	67	L	L	L
14	266	E	62	64	E	E	E
15	274		62	64			
16	1452		65	72			
17	1711		61	72			
18	726		59	63			
19	383		54	59			
20	390		56	60			
21	934		64	69			
22	2259		65	74			
23	414		56	66			
24	123		54	55			
25	352		58	61			
26	816		58	61			
27	1935		60	68			
28	318		60	61			
29	1892		65	76			
30	328		59	63			
31	2307		66	76			
SUM	40769	N.A.	-	-	-	-	-
AVG	1315	N.A.	61	69	N.A.	N.A.	N.A.
NBS ID	Q001		N113			N115	N114

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
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